

**DUAL-MIMICRY OF WASPS BY THE NEOTROPICAL LEAFHOPPER
PROPETES SCHMIDTI MELICHAR WITH A DESCRIPTION OF ITS FEMALE
(HEMIPTERA: CICADELLIDAE: CICADELLINAE)**

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Abstract.—Diagnostic features of the female of the Neotropical proconiine *Propetes schmidti* Melichar are described and illustrated for the first time. The genus *Propetes* Walker is newly recorded from the State of São Paulo, SE Brazil. The presence of an internal sclerotized plate from abdominal sternite VIII is reported in females of this genus for the first time. The following characteristics of *P. schmidti* suggest that it mimics epiponine wasps (Vespidae: Polistinae): color mostly black in the male and with large yellow areas in the female, pronotum convex, mesoscutellum swollen, forewings hyaline and elongate, and abdomen constricted basally. The different color patterns of males and females suggest a dual, sex-limited Batesian mimicry. This is the first record of mimicry in the tribe Proconiini and of dual-mimicry in an auchenorrhynchan group.

Key Words: Cicadellidae, *Propetes schmidti*, Batesian mimicry, dual-mimicry, Vespidae

Two valid species of the proconiine genus *Propetes* Walker were recorded by Young (1968). *Propetes compressa* Walker, the type species, occurs in northern and central-western Brazil (Pará, Amazonas, and Mato Grosso states) (Walker 1851, Signoret 1855, Melichar 1925, Schmidt 1928, Young 1968). *Propetes schmidti* Melichar is known from central-western Brazil (Mato Grosso do Sul State) (Melichar 1925) and is herein newly recorded from southeastern Brazil (São Paulo State). This genus is closely related to *Homalodisca* Stål (Young 1968), from which it can be distinguished by the following features: (1) head with a median carina on the transition crownfrons; (2) anterior portion of pronotum with a transverse sulcus; (3) scutellum swollen; (4) forewings hyaline; and (5) abdomen constricted basally. The first of these fea-

tures is apparently a synapomorphy of *P. compressa* and *P. schmidti* (Mejidalani, Takiya and Felix, in preparation). According to Young (1968), *Propetes* is very poorly represented in collections.

In this paper we describe and illustrate the diagnostic features of the female of *P. schmidti* for the first time. Morphological comparisons indicate that *P. schmidti* mimics wasps of the tribe Epiponini (Vespidae: Polistinae). Moreover, the occurrence of a remarkable sexual color dimorphism in this species suggests that males and females mimic different epiponine species. This kind of mimicry, in which each sex has its own model, is called dual-mimicry (Vane-Wright 1976).

Morphological terminology follows mainly Young (1968, 1977), except that of the head, which follows Hamilton (1981).

Techniques for preparation of genital structures follow those of Oman (1949). The dissected parts are stored in microvials with glycerin. Nomenclature of the wasp species follows Richards (1978) with modifications introduced by Carpenter and Day (1988).

Propetes schmidti Melichar
(Figs. 1–7, 9)

Propetes schmidti Melichar 1925: 336;
Metcalf 1965: 517; Young 1968: 206.

Description.—Length of female 13.2–14.0 mm; male 11.6 mm. Head, prothorax, and mesothorax pubescent. Head (Figs. 7 and 9) strongly produced, median length of crown exceeding interocular width, ocelli located before line between anterior eye angles, genae swollen. Pronotum (Figs. 7 and 9) with anterior transverse sulcus (more conspicuous in female), posterior margin deeply emarginated; mesonotum produced dorsally, lateral margins with strong declivity, scutellum swollen. Forewing (Figs. 7 and 9) hyaline and elongate, anterior portion of costal margin almost straight, exposing posterior meron. Foreleg with tibia expanded near apex. Abdomen (Figs. 7 and 9) constricted basally. Male genitalia, as well as other characteristics of head and thorax, as in the generic description of Young (1968: 204).

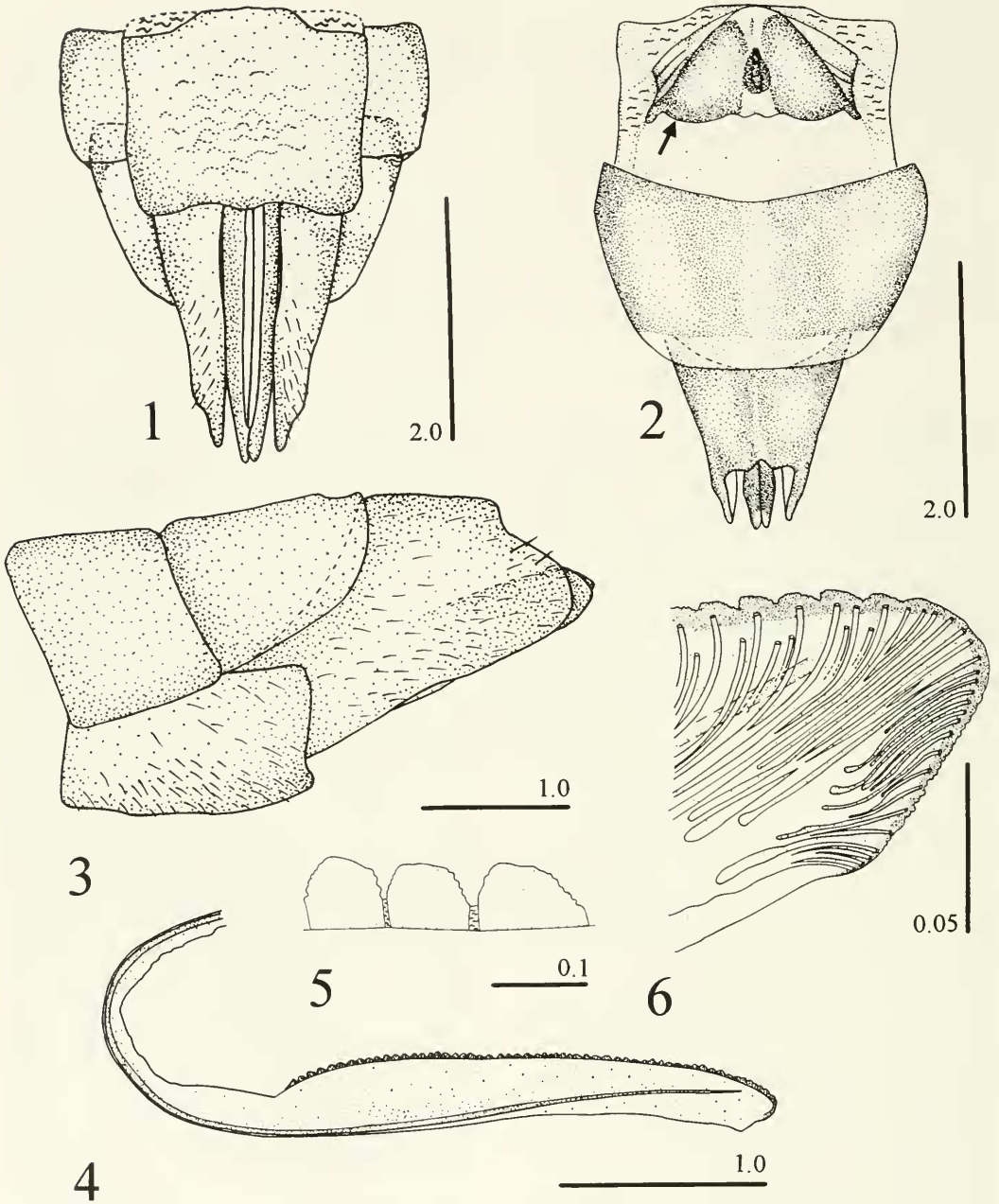
Female genitalia: Abdominal sternite VII (Fig. 1) with posterior margin transverse, with small, median blunt projection. Sternite VIII (Fig. 2) in dorsal aspect with two lateral, internal sclerotized plates weakly joined in middle portion, each with oblique fold. Pygofer (Fig. 3) in lateral aspect moderately produced, posterior margin convex, disc with numerous dispersed microsetae and few macrosetae. Second valvulae (Fig. 4) of ovipositor in lateral aspect regularly broadened beyond basal curvature, apex narrowly rounded, preapical prominence not very distinct, blunt, shaft dentate throughout broadened portion, teeth (Fig. 5) subquadrate, becoming gradually smaller, angulate, and more closely spaced

toward apex, denticles (Fig. 5) on teeth and ventral margin of shaft before apex (Fig. 6).

Color of female: Crown (Fig. 7) black, with median longitudinal stripe extending from apex to near base, pair of lateral stripes extending from apex to anterior margins of antennal ledges and curved mesally toward ocelli, and marks on antennal ledges and near inner margins of eyes, yellow; frons yellow, with transverse stripe and lateral margins, black; clypeus black, with basal yellow mark; gena yellow; lora brownish or black. Pronotum (Fig. 7) black, with lateral and posterior margins, pair of lateral longitudinal stripes originating from anterior transverse stripe, and median longitudinal stripe originating from posterior margin, yellow; mesonotum (Fig. 7) black, with lateral margins, anterior median stripe, and most of scutellum, yellow. Forewing (Fig. 7) amber. Abdominal tergites (Fig. 7) yellowish brown (or mostly black on tergites VI–IX), posterior margins with transverse brownish marks, tergites III and IV with large yellow marks.

Color of male: Crown (Fig. 9) black, with median longitudinal stripe extending from apex to about line between anterior margins of antennal ledges and marks on antennal ledges and near inner margins of eyes, yellow; frons black, with transverse stripe on superior portion and maculae on inferior portion, yellow; clypeus black; gena black, with yellow macula below antennae; lora black. Pronotum (Fig. 9) black, with lateral and posterior margins and three anterior maculae, yellow; mesonotum (Fig. 9) black, with pair of small anterolateral maculae and macula on posterior half of scutellum, yellow. Forewing (Fig. 9) amber. Abdominal tergites (Fig. 9) black, with yellow maculae.

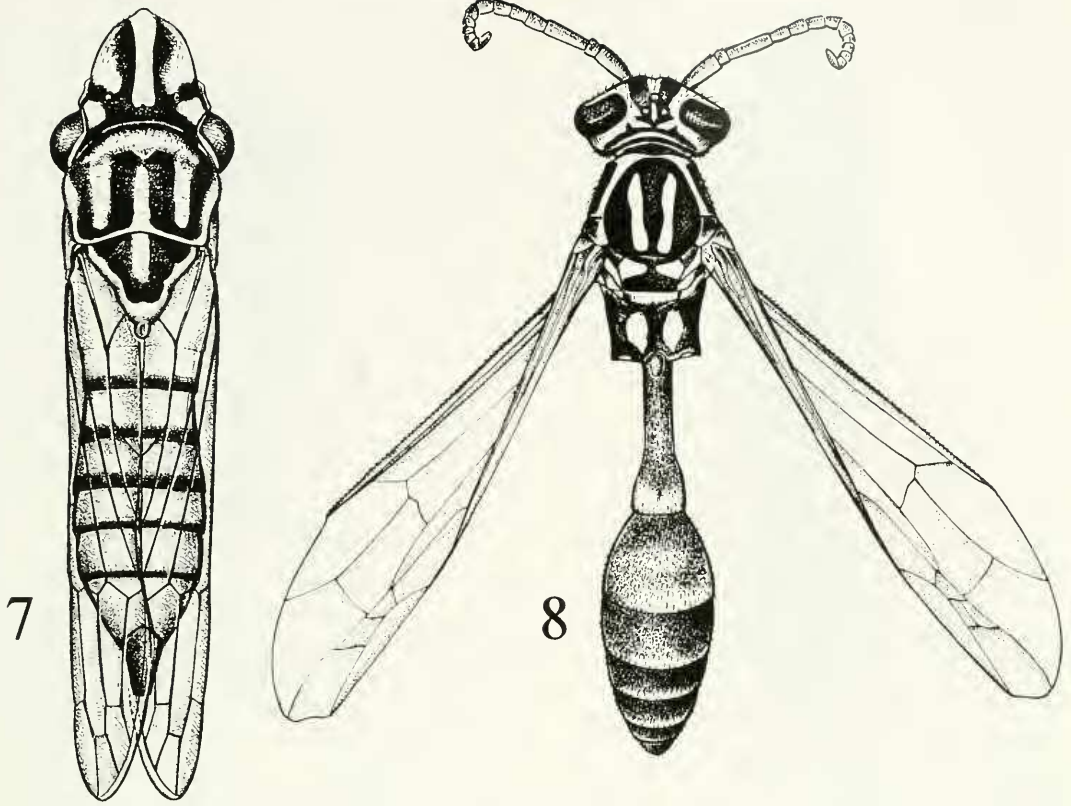
Material examined [lines on the specimen labels separated by a virgule (/)].—1 ♀ and 2 ♂, “Paulo de Faria-SP [São Paulo State]/Brasil 10-VII-1996/Yamamoto, P. leg.”; 2 ♀, “Bebedouro-SP/Brasil IV-1997/W. Peiffer col.”; specimens deposited in the Departamento de Zoologia da Universidade Federal



Figs. 1–6. Genital structures of the female of *Propetes schmidti*. 1–3, Apical abdominal segments. 1, Ventral view. 2, Dorsal view with tergite VII removed (arrow indicating internal sternite VIII). 3, Lateral view. 4–6, Second valvula of ovipositor. 4, General lateral view. 5, Teeth on median portion, lateral view. 6, Detail of apex showing denticles on ventral portion, lateral view. Scales in mm.

do Paraná (Curitiba, Brazil). 1 ♀ and 1 ♂, “Bebedouro-SP-BR [Brazil]/14/mai./1998/Roberto, S.”; specimens deposited in the Departamento de Entomologia da Escola

Superior de Agricultura “Luiz de Queiroz”, Universidade de São Paulo (Piracicaba, Brazil). Paulo de Faria and Bebedouro coordinates are 20°01'51"S 49°23'00"W and



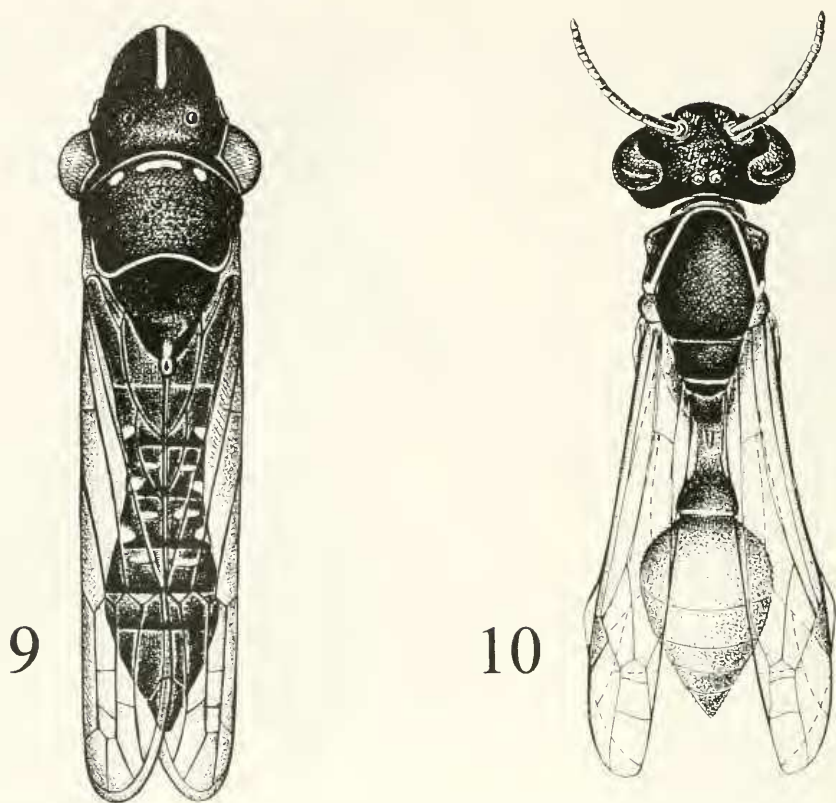
Figs. 7–8. 7. *Propetes schmidtii*, dorsal habitus of female, length 13.2 mm. 8. *Myschocyttarus ypiranguensis*, dorsal habitus, a model of the female of *P. schmidtii*, length 12.8 mm.

20°56'58"S 48°28'45"W, respectively. This is the first record of the genus *Propetes* from São Paulo State.

Notes.—The male genitalia of the aforementioned specimens of *P. schmidtii* agree well with the description and illustrations of Young (1968: 204). As described above, the male color pattern differs remarkably from that of the female. The similar external morphology of both sexes (including specimen size), allied to the collecting data, allowed us to identify them as belonging to the same species. The crown (Figs. 7 and 9) in *P. schmidtii* has a longitudinal yellow stripe (longer in the female) that is absent in *P. compressa*, the only other known species of the genus. The female from the former species can be easily identified by the presence of longitudinal and transverse yellow stripes on the pronotal disc (Fig. 7).

Unfortunately, the male of *P. compressa* is unknown. The specimens of *P. schmidtii* herein described vary in length from 11.6 to 14.0 mm, while specimens identified by previous authors as *P. compressa* are larger, varying from 15 to 18 mm (Signoret 1855, Melichar 1925, Schmidt 1928). The female abdominal sternite VII of *P. schmidtii* (Fig. 1) resembles that of *P. compressa*; the posterior margin of this sternite is almost rectilinear in both species.

The presence of an internally well developed sternite VIII (Fig. 2) is here reported in the genus *Propetes* for the first time. Sclerotized internal plates from this sternite were firstly observed by Nielson (1965) in the proconiine genera *Cuerna* Melichar and *Oncometopia* Stål, and later by Mejdalani and Emmrich (1998) in *Dichrophleps* Stål and Mejdalani (1998) in



Figs. 9–10. 9, *Propetes schmidtii*, dorsal habitus of male, length 11.6 mm. 10, *Polybia rejecta*, dorsal habitus, a model of the male of *P. schmidtii*, length 11.6 mm.

Tretogonia Melichar, *Homoscarta* Melichar, and *Ciccus* Latreille.

One female specimen of *P. schmidtii* has a pair of conspicuous, raised rounded chalky blotches on the forewings. These blotches were also observed by Signoret (1855: Pl. XXI, Fig. 9) in *P. compressa* and are found in females of some related genera. They are composed of protein-lipid bodies called brochosomes (R. Rakitov, in litt.; see Rakitov 1995). In *Oncometopia* and *Homalodisca* their formation is related to the preoviposition behavior (Turner and Pollard 1959, Nielson et al. 1975). The presence of these blotches may be a character of generic importance in the Proconini (Young 1968).

WASP MODELS

We studied 10 wasp species belonging to three genera of the tribe Epiponini: *Agelaia*

cajennensis (Fabricius), *A. myrmecophila* (Ducke), *A. pallipes* (Olivier), *A. vicina* (de Saussure), *Myschocyttarus parallelogrammus* Zikán, *M. wagneri* (du Buysson), *M. ypiranguensis* da Fonseca (Fig. 8), *Polybia jurinei* de Saussure, *P. quadricincta* de Saussure, and *P. rejecta* (Fabricius) (Fig. 10). The specimens examined are deposited in the Museu Nacional (Rio de Janeiro, Brazil) and were determined by O. W. Richards or J. F. Zikán.

These wasps occur within the geographical range of *P. schmidtii* (see Richards 1978). According to their color pattern, they can be easily divided into two groups: (1) species with the head and thorax mostly black; and (2) species with yellow markings on the head and longitudinal yellow stripes on the thorax. The first group includes the wasps belonging to the genus *Polybia* Le-

peletier and the second, to the genera *Myschocyttarus* de Saussure and *Agelaia* Lepeletier. The similarity observed in the color patterns of the species included in each of these groups suggests the existence of two rings of Müllerian mimics. Epiponine wasps often show an aggressive behavior, being mimicked by various insect species. Wasps in the genus *Agelaia*, for instance, are considered as models for some Miridae (Heteroptera), Asilidae and Stratiomyidae (Diptera), and Mantispidae (Neuroptera), as well as for cicadelline leafhoppers in the genus *Lissoscarta* Stål (Richards and Richards 1951, Mejdalani and Felix 1997).

DISCUSSION

Propetes schmidtii is approximately the same size as the epiponine wasps. In terms of morphology, the constriction at the base of its abdomen is a remarkable feature. This constriction mimics the petiole at the base of the abdomen of the proposed models. The forewings of *P. schmidtii* are elongate and hyaline, resembling those of the wasps. In addition, its convex pronotum and swollen mesoscutellum resemble, respectively, the mesoscutum and mesoscutellum of the wasps. Interestingly, these morphological features (except the swollen scutellum) are also present in the genus *Lissoscarta* (Boulard 1978, Mejdalani and Felix 1997).

As noted before, there is a remarkable color dimorphism between the female and the male of *P. schmidtii*. The former (Fig. 7), which has larger yellow areas and stripes, resembles the epiponines from the genera *Myschocyttarus* (Fig. 8) and *Agelaia*. The latter (Fig. 9), which is mostly black with smaller yellow areas and stripes, resembles the epiponines from the genus *Polybia* (Fig. 10). Therefore, it appears to us that the female and the male of *P. schmidtii* each have a different group of Müllerian mimics as models.

According to the terminology and analytic schemes proposed by Vane-Wright (1976), this is a case of Batesian mimicry (class VI, antergic defensive). In addition to

the aforementioned morphological and color features of *P. schmidtii*, it should be noted that this species is apparently rare (see Young 1968), an aspect that corroborates this hypothesis of mimicry. The predators (operators) from which such mimicry affords protection are unknown. Thus, it is not possible to establish at this time whether this mimicry is disjunct (mimic, model, and operator are different species) or bipolar (model and operator are the same). At least three other cases of class VI mimicry have been reported in the Auchenorrhyncha. One of them is the aforementioned leafhopper genus *Lissoscarta*, which also mimics epiponine wasps. Hogue (1984) suggested that fulgorids in the genus *Fulgora* Linnaeus avoid predation by mimicking arboreal lizards. Zolnerowich (1992) described a fulgorid nymph, *Amycle* sp., that mimics jumping spiders (Salticidae). In the first case Mejdalani and Felix (1997) were also unable to distinguish between the disjunct and bipolar classes of specific composition. In the last two cases the model and operator were considered the same (bipolar).

Vane-Wright (1976) observed that the models in class VI mimicry are often members of Müllerian mimicry groups (class IA, synergic warning). Our conclusion that members of two different color groups of wasps are models for *P. schmidtii* is in accordance with his observation. The existence of such distinct models for each sex of *P. schmidtii* is a case defined by Vane-Wright (1976) as dual-mimicry. According to that author, this kind of mimicry occurs rarely in Lepidoptera and more commonly in Hymenoptera (e.g., Evans 1968). This is the first report of mimicry in the Proconiini and the first one of dual-mimicry in an auchenorrhynchan group.

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